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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

KOIKE et al

Atty. Ref.: 461-62

Serial No. 09/546,227

Group: 1754

Filed: April 10, 2000

Examiner: E. Johnson

For: A CERAMIC SUPPORT CAPABLE OF  
SUPPORTING A CATALYST...

\* \* \* \* \*

February 2, 2005

**Mail Stop Appeal Brief – Patents**

Commissioner for Patents  
P.O. Box 1450  
Arlington, VA 22313-1450

Sir:

**COVER PAGE TO SUPPLEMENTAL APPEAL BRIEF**

Attached herewith is a Supplemental Appeal Brief which is to replace the Appeal Brief previously filed on November 22, 2004. The Supplemental Appeal Brief corrects the date of the final rejection from which the pending appeal has been taken to the final rejection issued by the Examiner on August 25, 2004. In addition, the Supplemental Appeal Brief provides additional information and reasons as to why Appellants' inventions patentably define over the cited references relied upon by the Examiner in rejecting the appealed claims. Finally, a new Appendix has been added (renumbered as Appendix II) which provides explanatory drawings explaining the Appellants' inventions in contrast to the prior art.

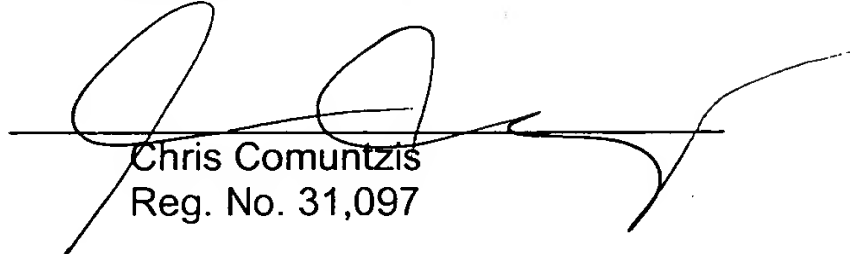
**KOIKE et al**  
**Serial No. 09/546,227**  
**February 2, 2005**

Appellants respectfully request that the Supplemental Appeal Brief be entered into this pending appeal.

Respectfully submitted,

**NIXON & VANDERHYTE P.C.**

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**SUPPLEMENTAL APPEAL BRIEF**

Appellants hereby appeals the Final Rejection of August 25, 2004.

**REAL PARTY IN INTEREST**

The real parties in interest are Appellants, Nippon Soken, Inc. and Denso Corporation.

**RELATED APPEALS AND INTERFERENCES**

The Appellants and the undersigned are not aware of any related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

### **STATUS OF THE CLAIMS**

Claims 73-78, 80-99, 102 and 103 remain pending in this application. Claims 73-78, 80-86, 94-99 and 102 stand rejected by the Examiner, the rejections of which are appealed. Claims 87-93 and 103 have been allowed. All of the claims are presented in the Appendix I to this Brief.

### **STATUS OF ANY AMENDMENT FILED SUBSEQUENT TO ANY FINAL REJECTION**

No amendments have been filed subsequent to the Final Rejection.

### **SUMMARY OF CLAIMED SUBJECT MATTER**

Independent claim 73 is directed to a ceramic support for supporting a catalyst component used, for example, for cleaning exhaust gas from an automobile's internal combustion engine. The ceramic support has a number of pores for directly supporting the catalyst component either within or at least partially within the pores of the ceramic support. Thus Appellants' invention provides a ceramic support for supporting a catalyst component without a coating of  $\gamma$ -alumina. (See Sheet 3/3 in Appendix II for explanatory drawing showing support of a catalyst component in the prior art.) The embodiment of claim 1 is shown in Figure 1 and described in the specification at, *inter alia*, p. 3, l. 34 – p. 4, l. 11. (See Sheet 2/3 in Appendix II for explanatory drawing showing direct support of catalyst within fine pores.)

Independent claim 80 is directed to a catalyst-ceramic body having a ceramic support with a cordierite honeycomb structure. The cordierite composition of the honeycomb structure replaces at least one of Si, Al, and Mg with a metal having a catalyst activity. The embodiment of claim 80 is also shown in Figure 1 and described in the specification at, *inter alia*, p. 4, l. 12-16 and p. 23, l. 19 – p. 24, l. 1. (See Sheet 1/3 in Appendix II for explanatory drawing showing direct support of catalyst by replacing Si with Ga.)

#### **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

Whether claims 73, 76-77 and 80-83 are anticipated under 35 U.S.C. § 102(b) and whether claims 74 and 75 are obvious over 35 U.S.C. § 103 by Guile et al. (U.S. Pat. No. 5,716,899).

Whether claims 73, 76-86, 97 and 102 are obvious under 35 U.S.C. § 103 over Ichii et al. (U.S. Pat. No. 5,607,885) in view of Beauseigneur et al. (U.S. Pat. No. 5,346,722).

Whether claims 94, 96 and 98-99 are obvious under 35 U.S.C. § 103 over Ichii et al. in view of Knapton et al. (U.S. Pat. No. 4,189,405).

Whether claim 95 is obvious under 35 U.S.C. § 103 over Ichii et al. in view of Abe et al. (U.S. Pat. No. 5,489,865).

### WHETHER THE CLAIMS STAND OR FALL TOGETHER

With respect to the § 102 and § 103 rejections based on Guile et al., claims 73 and 77 stand or fall together; claims 74, 75, 76 and 77 stand or fall alone; and claims 80-83 stand or fall together.

With respect to the other § 103 rejections, claims 73, 76-77, 78, 84, 94, 95, 96, 97, 98 and 99 stand or fall alone , and claims 80-83, 85, 86 and 102 stand or fall together.

### ARGUMENTS WITH RESPECT TO THE ISSUES PRESENTED FOR REVIEW

#### Basic Difference Between Appellant's Invention and the Prior Art

In the prior art, a catalyst component is supported on a honeycomb body using a coating layer on the surface of the honeycomb body. In contrast to the prior art, Appellant's invention disperses with the coating layer in that the catalyst component is directly supported directly on the honeycomb body. However, in prior art publications or references, presence of a coating layer is not always mentioned. As a result, the Examiner has mistakenly taken the view that Appellant's invention is anticipated by the prior art. Appellant previously provided a Declaration by the inventor pointing out the Examiner's error (see copy of Declaration in Appendix III).

As noted above, the key feature of Appellants' invention, is supporting a catalyst component directly on a honeycomb body. Alternative ways that this key feature is accomplished are shown in Sheets 1/3 and 2/3 in Appendix II. Absent these features, it was not possible in the prior art to support a catalyst component directly on a honeycomb body.

Cited References

- (1) U.S. Patent No. 5,607,885 (hereinafter "Ichii et al.")

To obtain a cordierite having a low thermal expansion coefficient, glass particles of cordierite composition having fewer defects and a particle size of 1 mm or more are crystallized to form aggregates having an average crystal grain size of 50  $\mu\text{m}$  or more. The aggregates show hysteresis in their thermal expansion characteristic and a thermal expansion coefficient of  $10 \times 10^{-7}/^{\circ}\text{C}$  or less between room temperature and  $1000^{\circ}\text{C}$ .

- (2) U.S. Patent No. 5,346,722 (hereinafter "Beauseigneur et al.")

To improve the thermal shock resistance of a wash-coated catalyst support, a buffer solution is introduced in microcracks and less-than-5  $\mu\text{m}$  pores of a support to form gel at the boundaries between the buffer solution and the wash coat layer.

- (3) U.S. Patent No. 4,189,405 (hereinafter "Knapton et al.")

To prevent reduction of a catalyst noble metal by evaporation, etc., during use, an intermetallic compound represented by  $\text{A}_x\text{B}_y$  where A stands for Ru, Th, Pd, Ir or Pt, B stands for Al, Sc, Y, lanthanides, Ti, Zr, Hf, V, Nb or Ta, and x and y are integers, is deposited on a first coating layer containing a refractive metal oxide. Thus, a method for forming the first coating layer comprising impregnation, chemical treatment and anodizing, and a method for forming an intermetallic compound are disclosed.

- (4) U.S. Patent No. 5,489,865 (hereinafter "Abe et al.")

To provide a catalyst for cleaning an automobile exhaust gas excellent in thermal resistance and durability, an aluminum salt or alkoxide derivative is hydrolized to form an aluminum precursor sol or gel, the sol or gel is subjected to supercritical conditions and dried to obtain a porous aluminum body, the porous aluminum body is

fired to form an activated alumina, a noble metal is added to the activated alumina, and the thus obtained activated alumina is coated and supported on a monolith supporting body. It is considered that an alumina porous body is formed under the supercritical conditions.

(5) U.S. Patent No. 5,716,899 (hereinafter "Guile et al.")

To obtain a honeycomb body with cell walls having a high strength and high porosity, activated charcoal and zeolite are pushed into pores of the cell walls.

As will be explained in detail below, none of the references discloses or suggests Appellants' invention.

#### Rejection under 35 U.S.C. § 102

The Examiner's Final Office Action has improperly rejected claims 73, 76-77 and 80-83 as being anticipated under 35 U.S.C. § 102(b) by Guile et al.

Under 35 U.S.C. § 102, a patent claim is invalid if it is anticipated by a single prior art reference. *Glaxo Inc. v. Novopharm Ltd.*, 52 F.3d 1043, 1047, 34 USPQ2d 1565, 1567 (Fed. Cir. 1995). To anticipate a patent claim, a prior art reference must disclose every limitation of the claimed invention, either explicitly or inherently. *In Re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1431 (Fed. Cir. 1997).

Claim 73 clearly recites that a catalyst component is directly supported within or at least partially within the pores of the ceramic support. In rejecting this claim as being anticipated by Guile et al. the Examiner has improperly ignored this limitation, which the cited reference is not believed to teach or suggest.



Guile et al. discloses its catalytic material as a catalyst metal or catalyst metal oxide dispersed on an active material such as activated carbon or zeolite. Accordingly, Guile et al. does not disclose a catalyst directly supported on a ceramic body, as required by claim 73. Instead, Guile et al. discloses the use of an intermediate material such as activated carbon between the substrate and the catalyst metal. Accordingly, claim 73 and its dependent claims 76-78 are believed to patentably define over the cited reference.

The Examiner states that "Guile '899 discloses a catalyst comprising a pore-impregnated ceramic body (see abstract)." Actually, the abstract states that pores are impregnated with an active material. The active material mentioned in Guile et al. are activated carbon, zeolite and combinations thereof (see, for example, claim 5). Although Guile et al. at col. 5, line 10 mentions that the active material can be a catalytic material, the catalytic material is a highly dispersed catalyst metal or catalyst metal oxide on an active material as described at col. 7, lines 9-12. That is, the catalyst metal or catalyst metal oxide is impregnated in pores of the body using the active material on which they are supported, i.e., the catalyst metal or catalyst metal oxide is not impregnated directly in pores of the body.

At page 7 of the final Office Action the Examiner alleges that Appellants used open claim language, i.e., "comprising" to claim a catalyst "which allows for the possibility of more than just the claimed catalyst component to be supported on the substrate." Thus, the Examiner has misconstrued the claim which does not claim a catalyst, as alleged by the Examiner, but rather claims "[a] catalyst ceramic body comprising a ceramic support . . . and a catalyst component directly supported within, or

at least partially within, the pores of said ceramic support." The latter limitation requires that the catalyst be directly supported within or partially within the pores of the ceramic support. Guile et al. does not meet this limitation because an active material, i.e., activated carbon or zeolite, is disposed between the catalyst and support.

In rejecting claim 80, the Examiner alleges that Guile et al. discloses "cordierite, Si, and Al (see column 3, lines 27-38 and 46)." Appellants respectfully disagree. Guile et al. describes some materials that are especially suited to the practice of its disclosed devices. More particularly, Guile et al. at column 3, lines 27-46 states:

The substrate materials are those that include as a predominant phase: ceramic, glass-ceramic, glass, cermet, metal, oxides, and combinations thereof. By combinations is meant physical or chemical combinations, e.g., mixtures, compounds, or composites. Some materials that are especially suited to the practice of the present invention, although it is to be understood that the invention is not limited to such, are those made of cordierite, mullite, clay, talc, zircon, zirconia, spinel, alumina, silica, borides, lithium aluminosilicates, alumina silica, feldspar, titania, fused silica, nitrides, borides, carbides, e.g., silicon carbide, silicon nitride or mixtures of these. Some typical ceramic substrates are disclosed in U.S. Pat. Nos. 4,127,691 and 3,885,977. Those patents are herein incorporated by reference as filed. Especially suited substrate materials are cordierite, mullite, and combinations thereof. Other types of bodies are porous metal bodies. Some preferred types of porous metal bodies, although it is to be understood that the invention is not limited to such, are bodies made of iron group metals such as, for example, Fe-Al or Fe-Cr-Al with optional additions for enhancement of various properties.

Thus, it should also be clear that Guile et al. simply does not disclose "a honeycomb structure comprising at least as a main component a cordierite composition, wherein at least one of Si, Al and Mg elements constituting the cordierite composition being

replaced by a metal having a catalyst activity" as required by present claim 80. The importance of this feature of Appellant's invention is clearly disclosed in the present application and graphically shown by sheet 1/3 in Appendix II.

The Examiner has ignored the express claim language requiring that at least one element of Si Al and Mg is replaced by a metal having catalyst activity. At page 8 of the final Office Action the Examiner argues that the "replacing" limitation "appears to be a process step limitation rather than a product limitation" and therefore gives the limitation no patentable weight. To the contrary, the limitation is directed to a particular structure of a "catalyst-ceramic body" structure in which a catalytic material is included within the honeycomb structure, and this particular structure is clearly not anticipated (or obvious over) the cited reference.

However, from the above it is clear that while Guile et al. discloses cordierite, including a Si compound and an Al compound as the substrate material, it does not disclose Si and Al of cordierite being replaced by a metal having a catalyst activity as required in claim 80.

Accordingly, claim 80 and its respective dependent claims 81-86 and 102 also patentably define over the cited reference.

The Examiner states "regarding claims 76-77, 81-83, Guile discloses vanadium oxide and copper filling the pores (see column 7, lines 44-48) and ceria (see column 3, line 27-38)." However, column 7, lines 44-48 discloses vanadium oxide and Cu mordenite, but not copper. Cu mordenite is not a catalyst component of the present invention and column 3, lines 27-38 of Guile et al. does not disclose ceria.

Rejections Under 35 U.S.C. § 103

Under 35 U.S.C. §103, a patent claim is invalid if the differences between its subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. *Litton Systems Inc. v. Honeywell Inc.*, 87 F.3d 1559, 1566, 39 USPQ2d 1321, 1325 (Fed. Cir. 1996).

The determination of obviousness is a question of law based on underlying factual inquiries. *Kegel Co. v. AMF Bowling Inc.*, 127 F.3d 1420, 1430, 44 USPQ2d 1123, 1130 (Fed. Cir. 1997). The ultimate determination as to obviousness is based on four factual inquiries: the scope and content of the prior art, the differences between the claims and the prior art, the level of ordinary skill in the pertinent art, and secondary considerations, if any, of non-obviousness. *Id.*

A. In View of Guile et al.

Claims 74-75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Guile et al.

The Examiner alleges that Guile et al. discloses 0.6% Pt metal. However, although col. 12, line 60 discloses 0.6% Pt, this Pt is entrained in zeolite by ion exchange.

The Examiner admits that Guile et al. fails to disclose an average distance between particles of 0.1-100 nm, but alleges that it would have been obvious to "select an average distance between particles of 0.1-100nm in the catalyst of Guile because Guile discloses an average support particle diameter of 2-6 microns (see column 6, lines 13-17), which would obviously...suggest an average distance of 0.1-100nm since it

is within a range that is smaller than the diameter and greater than the disclosed pore size of 2-15 angstroms."

However, col. 6, lines 13-17 discloses a particle size of activated carbon of 2-6  $\mu\text{m}$  and col. 5, line 24 discloses a fine pore size of activated carbon of 2-15Å, but Guile does not disclose an average distance between catalyst particles. There is no relationship between the particle size of activated carbon or the fine pore size of activated carbon and the average distance between catalyst particles, or there is no suggestion that there is such a relationship between the above.

Accordingly, claims 74 and 75 would not have been obvious in view of Guile et al.

B. Ichii et al. in view of Beauseigneur et al.

The Examiner has improperly rejected claims 73, 76-86, 97 and 102 as being unpatentable over Ichii et al. in view of Beauseigneur et al.

In rejecting claims 73 and 77-86, the Examiner states that

Ichii '885 discloses a cordierite honeycomb (see column 3, lines 43-47), with a lattice defect with oxygen vacancies and oxygen storing capability (see column 1, lines 63-66; the term 'capability' indicating oxygen may or may not be stored), a composition of more than 48% by weight (see column 5, lines 29-30), and a honeycomb catalyst carrier without a coating (see column 1, lines 17-19), heating to form microcracks, and reheating (see column 4, lines 60-67).

Ichii '885 fails to specifically disclose ceria, catalytic metal, and pore size of 100 nm or less.

Beauseigneur '722 discloses ceria (see abstract), transition metals (see column 6, line 29, and column 7, lines 65-68), and pore size of less than 5 microns (see column 3, lines 67-68).

However, col. 1, lines 63-66 of Ichii et al. does not discloses a lattice defect with an oxygen defect or oxygen storing capability at all. Column 5, lines 29-30 discloses only the theoretical composition of cordierite. The theoretical composition is expressed in terms of oxides of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$  and  $\text{MgO}$ , but does not mention the amount of the oxygen in the cordierite. Column 1, lines 17-19 do not disclose a cordierite honeycomb without a coating and mentions only that the cordierite honeycomb is used for cleaning an automobile exhaust gas. Ichii et al. simply does not discloses a cordierite honeycomb without a coating.

Since Ichii et al. is directed to improvement of thermal expansion characteristics of cordierite and does not confirm the effect in the form of cordierite on which a catalyst is supported, it does not show how a catalyst is supported on a support at all. Therefore, Ichii et al. does not disclose cordierite directly supporting a catalyst without a coating.

Moreover, as Appellant explained in the Amendment filed on September 4, 2002, together with the Declaration of co-inventor Masakazu Tanaka (attached hereto as Appendix III), no mention of a coating in Ichii et al. does not mean that a coating is not necessary. In any event, the Examiner admits that Ichii et al. does not disclose a catalyst.

Also, the abstract of Beauseigneur et al. does not disclose ceria, while col. 6, line 14 mentions ceria. Column 6, line 29, mentions transitional metals, but the transitional metal is only mixed with alumina and is not substituted for an element of alumina. Column 7, lines 65-68 does not show transitional metals while col. 8, lines 3-4

shows transitional metals. Column 7, lines 3-4, does show a wash coat. Column 3, lines 67-68 show only the definition of micropores (less than 5  $\mu\text{m}$ ).

The Examiner alleges that combining Ichii et al. and Beauseigneur et al. would have been obvious to a person ordinarily skilled in the art at the time of Appellant's invention, since Beauseigneur et al. "discloses his ceria as particularly preferred (see column 6, lines 54-55), in a method of improving thermal shock resistance (title), in a honeycomb cordierite (see column 1, lines 5-24), to support catalyst metals for use as catalyst (see column 7, lines 65-68)."

The Examiner also states that regarding "claims 76-86, Beauseigneur et al. '722 discloses pores diameter less than 5  $\mu\text{m}$  (see column 3, lines 67-68) and catalyst metals (see column 7, lines 65-68), including noble metals (see column 8, lines 65-66)."

Although col. 8, lines 65-66 shows noble metals, these noble metals are present on  $\gamma$  alumina (see column 8, lines 65-66).

However, ceria disclosed at col. 6, lines 54-55, is a binder in an alumina slurry and col. 3, lines 67-68 shows only the definition of micropores (less than 5  $\mu\text{m}$ ).

Concretely, the improvement of thermal shock of Beauseigneur et al., as the title states, is in introducing a buffer solution into microcracks and into pores having a size less than 5  $\mu\text{m}$  in diameter before coating with a washcoating slurry, by which introduction of the washcoating slurry into the microcracks and less than 5  $\mu\text{m}$  pores is prevented.

Accordingly, it is clear that the microcracks and less than 5  $\mu\text{m}$  pores are not used for supporting a catalyst. Also, Fig. 1 and col. 7, lines 59-64 show the structure of the catalyst/support composite of Beauseigneur et al. (a catalyst is not directly supported by

the microcracks and less than 5  $\mu\text{m}$  pores).

Even if Ichii et al. and Beauseigneur et al. are combined, Appellant's invention would not result since Ichii et al. does not show directly supporting a catalyst and Beauseigneur et al. does not show a catalyst directly supported on microcracks and less than 5  $\mu\text{m}$  pores.

Moreover, the Examiner's allegations that Beauseigneur et al. discloses pore diameter less than 5 microns (see column 3, lines 67-68) and catalyst metals (see column 6, line 29 and column 7, lines 65-68) are simply wrong. Beauseigneur et al. does not teach or suggest the features of independent claim 73 of the present application, namely, a catalyst directly supported within or partially within the pores of the ceramic support.

The Examiner's citation that Beauseigneur et al., *inter alia*, disclosed micro pores having a size of less than 5  $\mu\text{m}$  is not even relevant to Appellants' inventions. (With reference to the following arguments, please see the sheet of figures attached hereto as Appendix IV.)

From the above, it is clear that Beauseigneur discloses a method for solving a problem associated with the provision of a washcoat layer for a catalyst. That is, Beauseigneur discloses that a coating layer having a large surface area such as a washcoat is necessary for a ceramic honeycomb. If the micro pores having a pore size less than 5  $\mu\text{m}$  are effective to support a catalyst component, a washcoat layer is not necessary. Nevertheless, since a washcoat layer is formed in Beauseigneur et al., it clearly suggests that the micro pores of a ceramic honeycomb of Beauseigneur et al. cannot support a catalyst component.



In Beauseigneur et al., the entry of a washcoat layer – comprising a catalyst component—into micro pores having a pore size of less than 5  $\mu\text{m}$  is prevented by formation of a gel at the micro pores so as to provide a support having thermal shock resistance. Therefore, a catalyst component (catalyst particles), present in the washcoat layer is not even partially within the micro pores having a pore size less than 5  $\mu\text{m}$  (see the upper figure of the attached sheet in Appendix IV and the cited reference at Figure 3, column 2, lines 3-19, and column 3, line 64 through column 4, line 8).

In contrast, in Appellants' inventions, catalyst components are present within the fine pores of a support having a fine pore size of 100 nm or less (see the middle figure of the attached sheet in Appendix IV and compare 5  $\mu\text{m}$  with 100 nm or less). In Appellants' inventions, even if fine pores are less than 0.1  $\mu\text{m}$  in size, a catalyst component can still be partially supported within the fine pores (see the lower figure of the attached sheet).

In rejecting claim 78, the Examiner alleges that Ichii et al. "discloses microcracks on particles of 50 microns, which disappear (see abstract and column 8, lines 52-55)."

However, although particles of 50  $\mu\text{m}$  and microcracks are disclosed, there is no teaching at all that a catalyst can be directly supported by the microcracks. Beauseigneur et al. discloses only improvement of thermal expansion characteristics and does not teach how to support a catalyst at all.

More particularly, as can be seen in the Abstract, Ichii et al. discloses only particles (crystal diameter) of 50 microns or more, not microcracks of 50 microns or less. Similarly, the Examiner's reference to column 8, lines 52-55, (which refers to

Table 1) merely describes particles having a crystal diameter of more than 30 microns but makes no mention of microcracks of 50 microns or less. Accordingly, claim 78 is believed to further patentably define over the cited art.

Nor can any relevant citations from the cited references be located for teaching the features of claims 80-83, 85, 86 and 102. As noted above, the Examiner combines Ichii et al. with Beauseigneur et al., but in no way provides any reference as to which portions of the Ichii et al. and Beauseigneur et al. references are to be applied against these claims. With respect to independent claim 80 it appears that the Examiner has again improperly ignored the limitation that the honeycomb structure has a cordierite composition in which a catalyst is provided in place of either Si, Al, or Mg. Since this limitation is not found in the cited art, claim 80 and its dependent claims 81-86 and 102 are believed to patentably define over the cited art.

In rejecting claim 97, the Examiner alleges that Ichii "discloses mixing and pouring both of which would cause vibration in a liquid." However, Appellants respectfully submit that Ichii only discloses pouring a melt in water and does not disclose application of vibration during catalyst supporting as required by claim 97.

More particularly, the teaching in Ichii has no relationship with claim 97 in which a catalyst is supported by using a solvent having a smaller surface tension than water. Accordingly, claim 97 is believed to further patentably define over the cited art.

The Examiner's rejection of claim 103 appears to be a typographical error since this claim has been allowed.

C. Ichii et al. in view of Knapton et al.

The Examiner has improperly rejected claims 94, 96 and 98-99 under 35 U.S.C. § 103(a) as being unpatentable over Ichii as applied to claim 73 above, and further in view of Knapton et al.

The Examiner states that regarding "claim 94, Ichii fails to disclose CVD or PVD." The Examiner then alleges that Knapton discloses chemical vapor deposition and cites to col. 5, lines 11-19 of that reference.

Moreover, the Examiner admits that Ichii alone does not invalidate claim 73. Since Knapton does not solve the deficiencies noted above with respect to Ichii, claims 94, 96 and 98-99 patentably define over the cited art. This follows because, Knapton discloses the use of CVD for forming an alumina layer, but does not disclose the use of CVD for catalyst supporting. Accordingly, there would have been no reason to combine Ichii and Knapton, but even if the references were combined Appellants' inventions as recited in claim 94 would not have resulted since the references do not teach or suggest using CVD (or PVD) to deposit a catalyst on the ceramic support.

More particularly, col. 5, lines 11-19 of Knapton describes how to form alumina, and does not disclose supporting a catalyst component. It is therefore clear from the Examiner's own citation that an alumina layer is present in Knapton.

The Examiner next alleges that it would have been obvious to "use the CVD of Knapton in the catalyst of Ichii because Knapton discloses the CVD in an intermetallic catalyst (title) to form an alumina layer on alloys which do not contain sufficient aluminum to form their own alumina layer (see column 5, lines 11-14) and to give the requisite compound (see column 2, lines 48-51)."

However, as noted above, col. 5, lines 11-14 of Knapton discloses the use of CVD to form an alumina layer. Although col. 2, lines 48-51 discloses CVD using  $ZrCl_4$  to form  $Pt_3Zr$ , Zr is vaporized to be deposited but Pt is not vaporized and is not deposited. On the other hand, Appellant's invention is characterized in that an alumina layer is not present and the catalyst is Pt, not Zr. Therefore, Appellant's invention would not have been obvious from a combination of Ichii and Knapton.

The Examiner states that regarding claim 96, USP'405 discloses water or organic solvent (see column 2, lines 56-58), which would obviously include organic solvents that have a higher surface tension than water.

However, col. 2, lines 56-58 discloses water or organic solvent but does not mention the surface tension of the organic solvent at all. Appellants' invention uses an organic solvent having a surface tension lower than that of water, not an organic solvent having a surface tension higher than that of water as the Examiner stated. Accordingly, claim 96 is believed to further patentably define over the cited art.

With respect to claims 98 and 99 it is respectfully submitted that Knapton does not teach or suggest the process of production recited in these claims. More particularly, Knapton et al. does not teach or suggest first depositing a catalyst on the ceramic support and then following with a heat treatment. Accordingly, claims 98 and 99 are believed to further patentably define over the cited references.

D. Ichii et al. in view of Abe et al.

The Examiner has improperly rejected claim 95 under 35 U.S.C. § 103(a) as being unpatentable over Ichii et al. in view of Abe et al.

The Examiner admits that Ichii fails to disclose supercritical conditions, but alleges that "Abe discloses drying gel under supercritical conditions (see column 3, lines 48-50),"

However, col. 3, lines 48-50 of Abe discloses only drying an alumina precursor under supercritical conditions, and does not disclose supporting a catalyst under supercritical conditions. The Examiner alleges that it would have been obvious to "use the supercritical conditions of Abe in the catalyst process of Ichii because Abe discloses the supercritical conditions in a catalyst process (title) to obtain a noble metal-dispersed alumina precursor or gel (see column 3, lines 47-48)."

However, Ichii et al. does not disclose the catalyst process. As noted above, prior art such as Ichii et al. have a coating layer present. Further, in Abe, since as shown in col. 3, lines 30-42, a catalyst metal is dispersed on alumina which is then supported on a monolith, it is clear that there is also an alumina coat layer. The supercritical conditions are used to dry an alumina precursor, and use of supercritical conditions to directly support a catalyst is not disclosed as required in Appellants' inventions. Therefore, even if it would have been obvious to combine these two references, Appellants' invention would not have resulted, since both references implicitly or explicitly disclose a coating layer.

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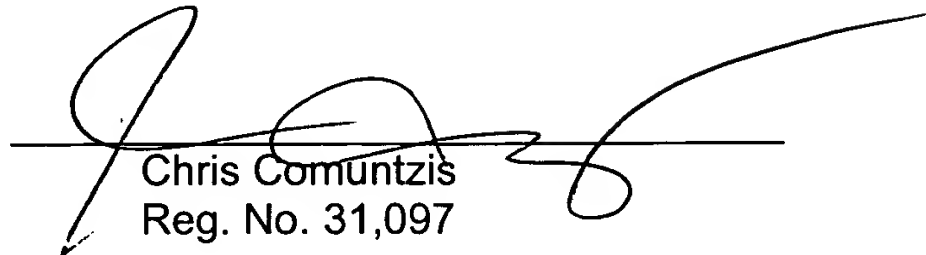
### **CONCLUSION**

For all of the reasons set forth above, it is respectfully requested that this appeal be granted and that the rejection discussed above be reversed.

Respectfully submitted,

**NIXON & VANDERHYE P.C.**

By: \_\_\_\_\_

  
Chris Comuntzis  
Reg. No. 31,097

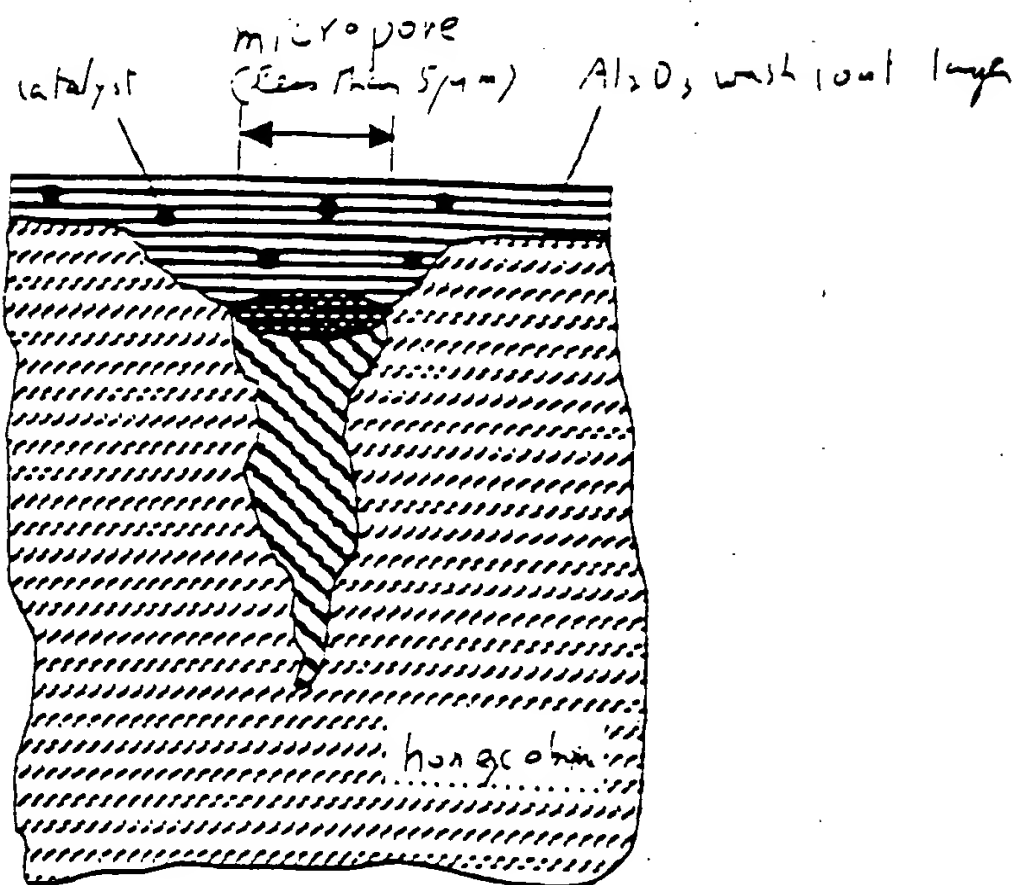
CC:Imr  
1100 North Glebe Road, 8th Floor  
Arlington, VA 22201-4714  
Telephone: (703) 816-4000  
Facsimile: (703) 816-4100



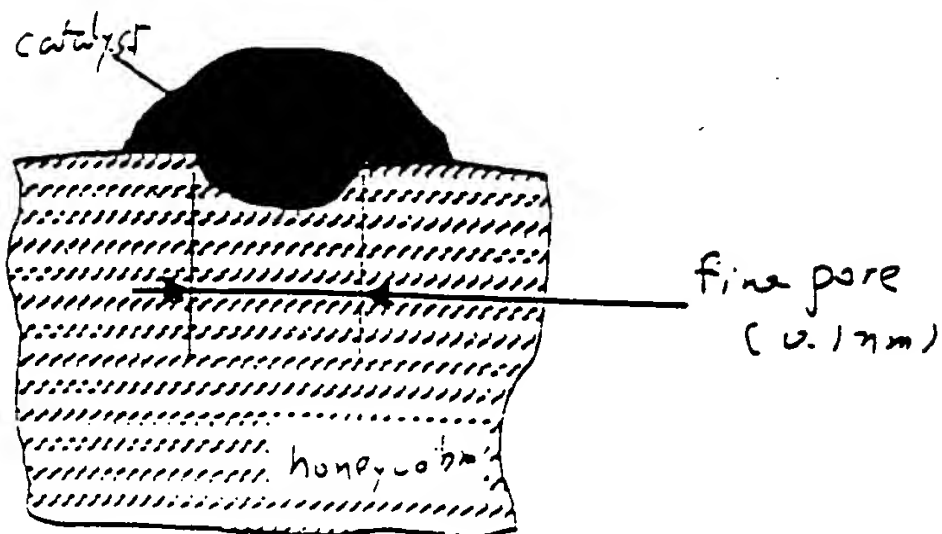
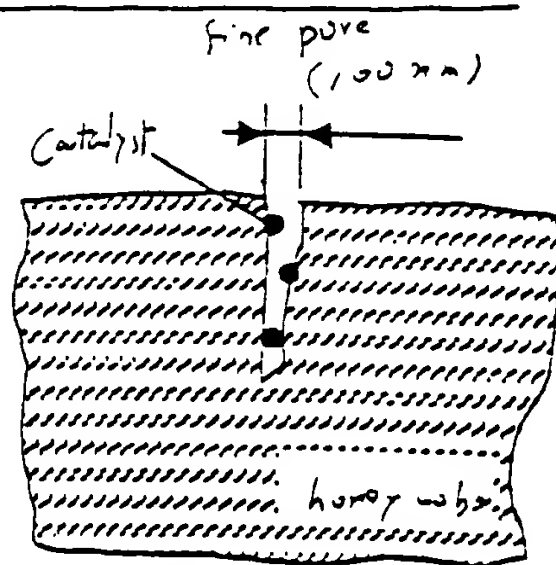
**APPENDIX IV**  
**SHEET OF FIGURES**



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PRESENT INTENTION

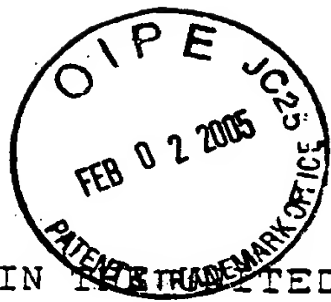






### APPENDIX III

### DECLARATION OF CO-INVENTOR MASAKAZA TANAKA



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

T. KOIKE, ET AL.

Group art Unit: 1754

Serial No.: 09/546,227

Examiner: JOHNSON, EDWARD M

Filed: April 10, 2000

For: A CERAMIC SUPPORT CAPABLE OF SUPPORTING A CATALYST, A  
CATALYST-CERAMIC BODY AND PROCESSES FOR PRODUCING SAME

DECLARATION UNDER 37 C.F.R. § 1.132

Honorable Commissioner of Patents and Trademarks,  
Washington, D.C. 20231

Sir:

I, Masakazu Tanaka, a citizen of Japan, residing at  
Urban-Life Sakae 501, Sakae-cho 4-62, Okazaki City, Aichi  
Pref. 444-0012, Japan, hereby declare the following.

1. I am a co-inventor of the above-identified patent  
application.

2. I obtained a masters degree from the Department of  
Chemical Engineering, Graduate School of Engineering, Kyushu  
University, where I studied fluid dynamics of mixture and/or  
agitation. I entered Nippon-Denso (now Denso Corporation) in

1987, and was appointed to the Research & Development Department where I was engaged in the development of an electric control suspension system for automotive use from 1987 to 1990, development of an electrically controlled tire air pressure system for automotive use from 1990 to 1993, and development of an exhaust gas purification system for automotive use from 1993 to 1998. I was then appointed to the Ceramic Engineering Department where I was engaged in the design and development of a ceramic honeycomb substrate for a catalyst converter.

3. As a person skilled in the art of automotive and ceramic honeycomb substrates for catalyst converters, I know that a catalyst is never supported on known ceramic supports when the catalyst is used in practice since the ceramic supports do not have a sufficiently high surface area. A high surface area material such as gamma-alumina is coated on a ceramic support such as a honeycomb structure and a catalyst is supported on the coated high surface area material. Without such a coating, a ceramic support cannot effectively support a sufficient amount of a catalyst directly thereon and such a catalyst-directly-supported ceramic support cannot be used as an affective catalyst or an affective catalyst-ceramic body.

I also know that it is a common practice that in

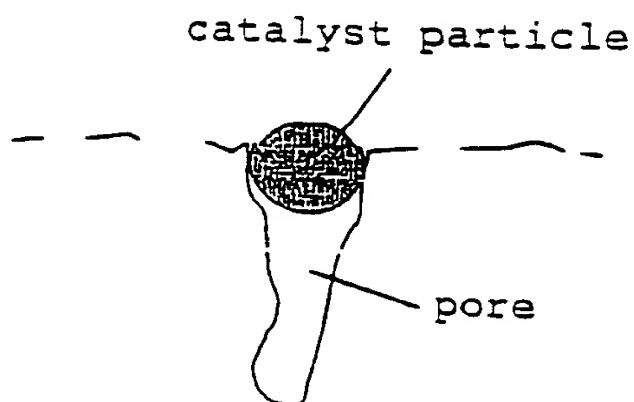
much literature, coating is not mentioned even though a catalyst must have been supported on a ceramic support, and that a person skilled in the art therefore understands that even if the coating was not mentioned in literature, a coating was actually formed on a ceramic support. I can almost surely guarantee the above knowledge as a person who has had been concerned with and worked with the technology of catalyst supporting. At least it is certain that failure to mention a coating does not necessarily mean that a coating was not formed, and even though the coating is not mentioned in Ichii'885, a person skilled in the art would not consider that no coating was formed in Ichii'885.

4. Next, I will show that a ceramic body having fine pores with a size of 0.1 to 100 nm can effectively support a catalyst but a ceramic body having pores with a size of more than 248 cannot effectively support a catalyst.

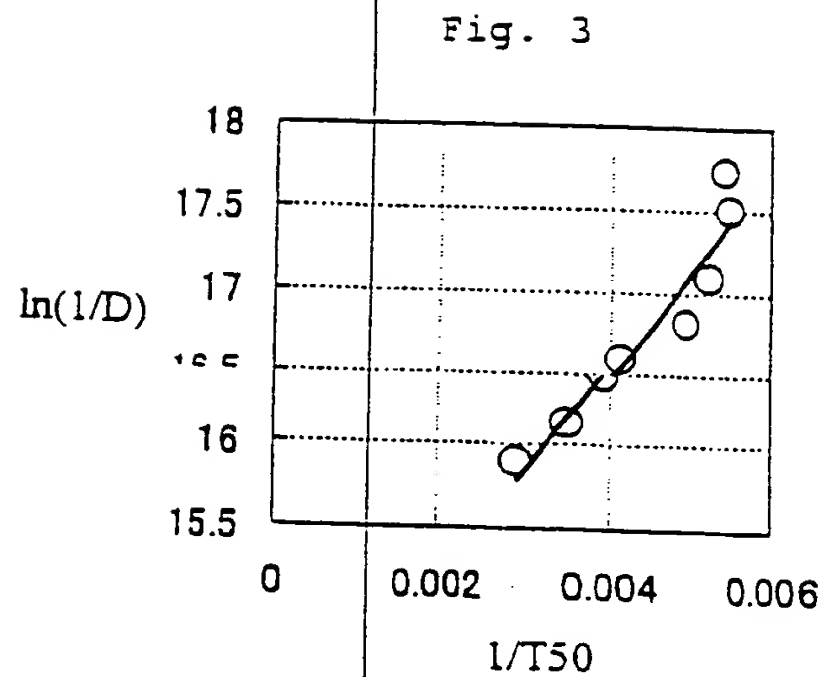
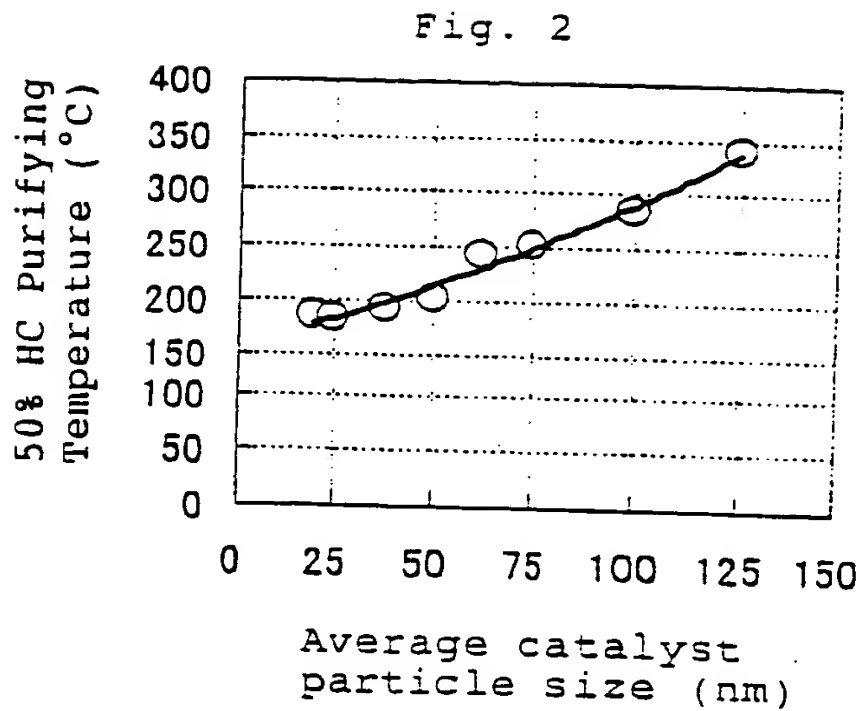
5. As shown in the following Fig. 1, it can be considered that the size of fine pores of a ceramic body corresponds to the size of a catalyst particle which can be supported by the fine pores. If the size of the catalyst particle is larger than the size of the fine pore, the catalyst particle cannot be fixed or supported by the fine pore. If the size of the catalyst particle is smaller than the size of the fine pore, the catalyst particle enters into

a deep portion of the fine pore and cannot effectively work as a catalyst since the catalyst particle does not contact a material to be catalyzed, for example, an exhaust gas to be purified.

Fig. 1



6. Using a cylindrical catalyst sample comprising activated alumina and catalyst particles and having a diameter of 15 mm and a length of 10 mm and a hydrocarbon sample gas, the temperature (T50) at which 50% of the hydrocarbon sample gas was purified was measured, while the particle size of the catalyst particle was varied. The mean particle size (D) of the catalyst particles was measured by the CO pulse adsorption method. The obtained result is shown as T50v. D in the following Fig. 2.



It is known that T50 and D have the following relationship:

$$\ln(1/D) = A/(T50) + B \quad (1)$$

Here Fig. 2 is reduced to Fig. 3 which shows the relationship between  $\ln(1/D)$  and  $(1/T50)$ . Fig. 3 shows that the formula (1) is satisfied. When the constants A and B in the formula (1) are obtained from Fig. 3,  $A = 645.45$  and  $B = 13.891$ . That is, the formula (1) can be expressed as:

$$\ln(1/D) = 645.45/(T50) + 13.891 \quad (1)$$

When no catalyst was used, T50 was measured to be 489°C.

This value of  $T_{50} = 489^{\circ}\text{C}$  is inserted into the formula (1), the mean catalyst particle diameter (D) becomes 248 nm.

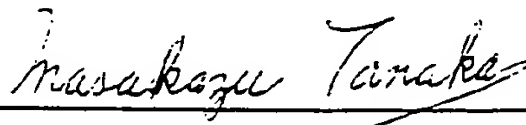
6. Therefore, it can be said that catalyst particles having a mean particle diameter (D) of larger than 248 nm exhibit substantially no catalyst performance.

In contrast, Fig. 3 shows that catalyst particles having a mean particle diameter (D) of 100 nm exhibit a sufficient catalyst performance as  $T_{50}$  is about  $300^{\circ}\text{C}$ .

7. As described above, since the fine pore size can be considered to be the diameter of supportable catalyst particles, fine pores having a mean particle diameter (D) of 100 nm can support catalyst particles having a sufficient catalyst performance, but pores having a mean particle diameter (D) of larger than 489 nm can hardly support catalyst particles having a sufficient catalyst performance.

I, the undersigned declarant, declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and; further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001, of Title 18, of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 9th day of August , 20 02

A handwritten signature in cursive script, reading "Masakazu Tanaka", written over a horizontal line.

Masakazu Tanaka





**APPENDIX II**  
**EXPLANATORY DRAWINGS**

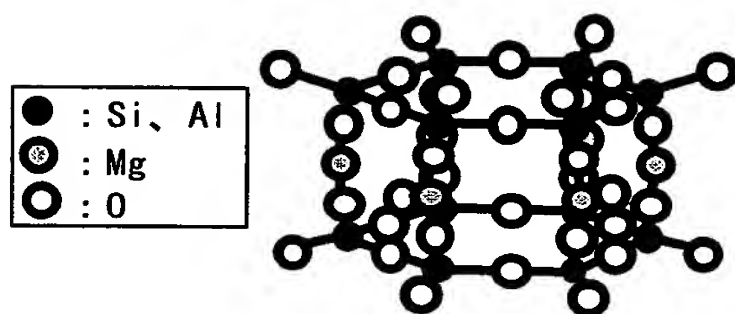


1/3

## MECHANISM OF CATALYST SUPPORTING OF PRESENT INVENTION (1)

### 1) Lattice Defects by Element Substitution

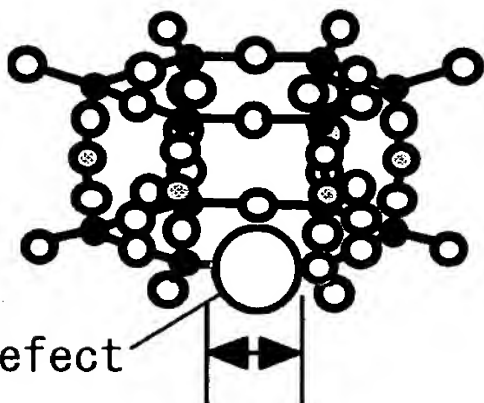
• Formation of lattice defects within cordierite crystal



Normal cordierite has a crystal structure as shown in the left figure



Element substitution  
Ex.)  $\text{Si} \rightarrow \text{Ga}$



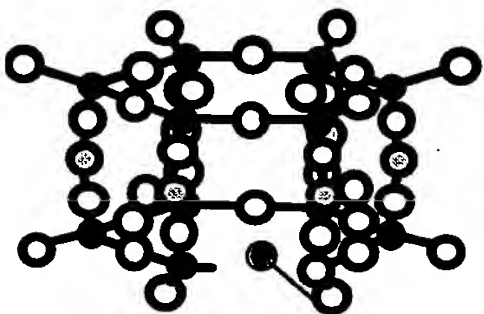
Oxygen defect

About 0.1nm

If among cordierite-composing elements, for example,  $\text{Si} (4^+)$  is substituted by  $\text{Ga} (3^+)$ , an oxygen defect is formed as shown in the left figure. The size of oxygen defect is about 0.1nm.



Catalyst support



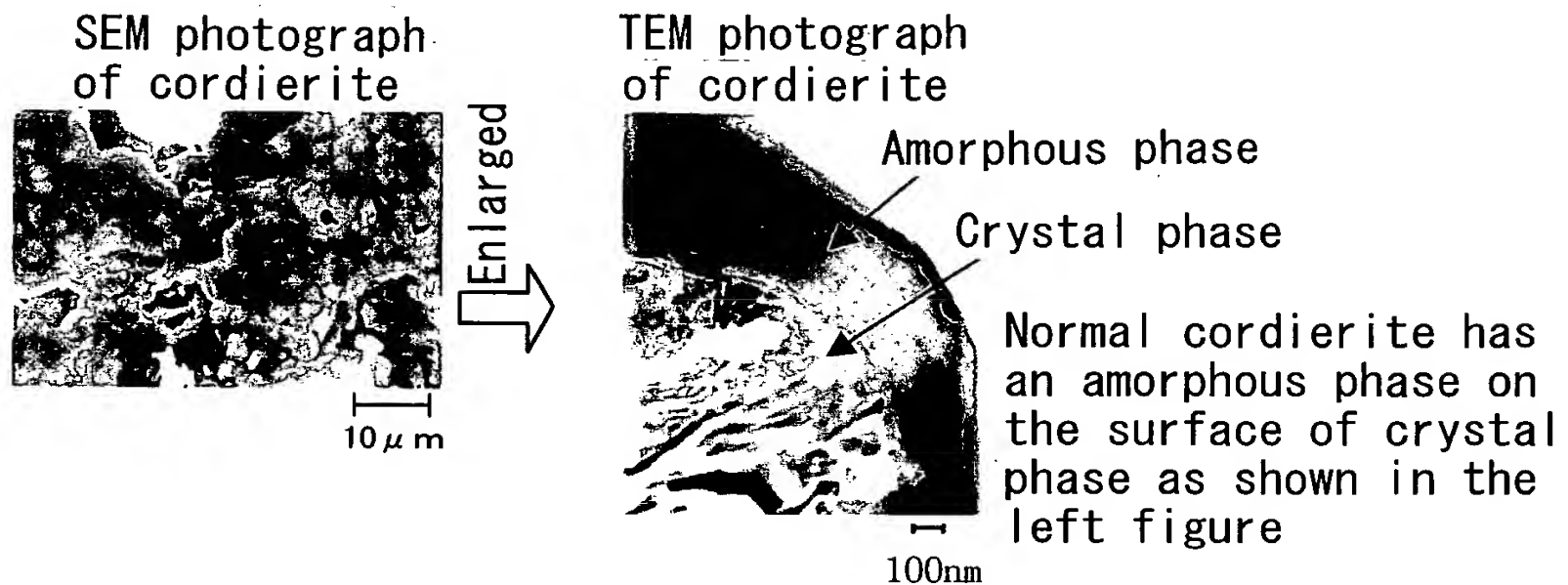
Catalyst noble metal ion

If a catalyst component is supported on a cordierite having an oxygen defect, the catalyst ion is supported at the oxygen defect, which is fired to become a catalyst metal

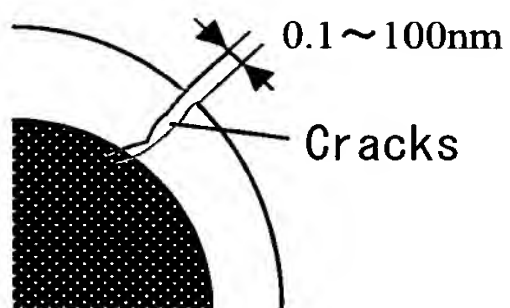
## MECHANISM OF CATALYST SUPPORTING OF PRESENT INVENTION (2)

### 2) Fine Cracks

·Formation of Cracks(fine cracks)in glass phase

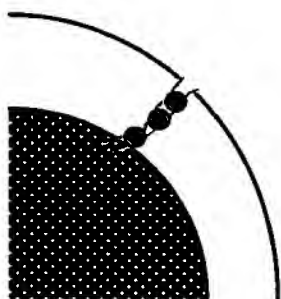


Thermal shock



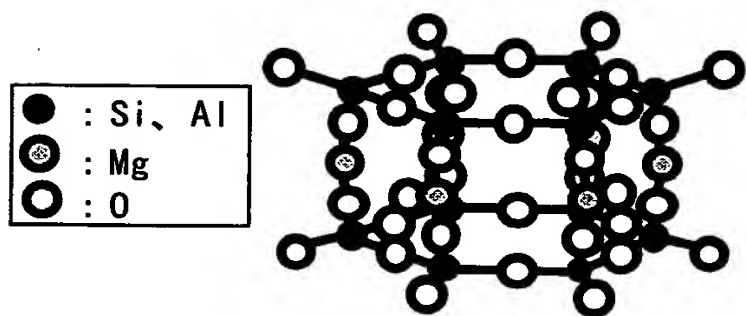
Giving thermal shock provides thermal stress due to difference in thermal expansion coefficient between amorphous and crystal phases, to form fine cracks, having a size in a range of 0.1-100nm

Catalyst supporting

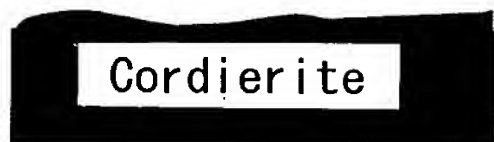


If a catalyst component is supported on a cordierite having fine cracks, catalyst ions are supported on fine cracks, which are fired to form a catalyst metal

## MECHANISM OF CATALYST SUPPORTING OF PRIOR ART

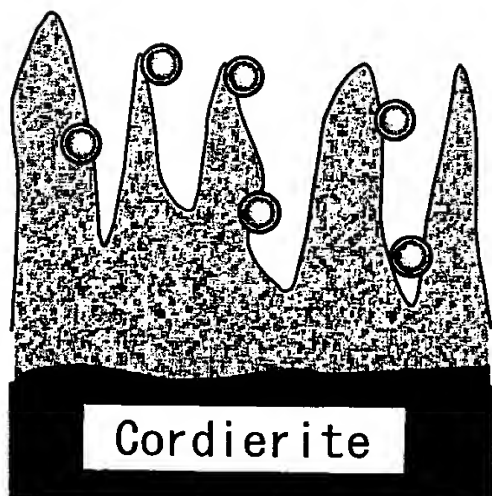


Normal cordierite has a crystal structure as shown in the left figure and does not have points to support a catalyst component



The left figure shows the surface of cell wall of a monolith support body, having a smooth surface for the catalyst component, so that there are no points to support a catalyst

↓ Catalyzed



By forming a  $\gamma$ -alumina layer having a large specific surface area on the surface of cordierite, a catalyst component is supported on the  $\gamma$ -alumina layer



## APPENDIX I

### CLAIMS ON APPEAL



## APPENDIX I: CLAIMS ON APPEAL

73. A catalyst ceramic body comprising a ceramic support having a number of pores and a catalyst component directly supported within, or at least partially within, the pores of said ceramic support.

74. The catalyst-ceramic body according to claim 73, wherein said catalyst-ceramic body comprises a catalyst component in an amount as the metal element of not less than 0.01% by weight, an average distance between particles of said catalyst component on the surface of said ceramic support being in a range of 0.1 to 1000 nm.

75. The catalyst-ceramic body according to claim 73, wherein an average distance between particles of said catalyst component is in a range of 0.1 to 100 nm.

76. The catalyst-ceramic body according to claim 73, wherein said catalyst component includes at least one component selected from the group consisting of metals having a catalyst activity and metal oxides having a catalyst activity.

77. The catalyst-ceramic body according to claim 76, wherein said metals having a catalyst activity are noble metals and said metal oxides having a catalyst activity are oxides containing at least one metal selected from the group consisting of V, Nb, Ta, Cr, Mo, W, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sn, and Pb.

78. The catalyst-ceramic body according to claim 73, wherein said ceramic support has a multiple number of fine pores with a diameter or width of 0.1 to 100 nm on the surface of the ceramic support.

80. A catalyst-ceramic body comprising a ceramic support comprising a honeycomb structure and having a cordierite composition, wherein at least one of Si, Al and Mg elements constituting the cordierite composition being replaced by a metal having a catalyst activity.

81. The catalyst-ceramic body according to claim 80, wherein said catalyst-ceramic body contains a metal having a catalyst activity in an amount of not less than 0.01% by weight thereof.

82. The catalyst-ceramic body according to claim 80, wherein said catalyst-ceramic body contains a metal having a catalyst activity in an amount of not less than 0.01% by weight thereof and  $\text{CeO}_2$  in an amount of not less than 0.01% by weight thereof.

83. The catalyst-ceramic body according to claim 80, wherein said metal having a catalyst activity includes at least one material selected from the group consisting of noble metals, V, Nb, Ta, Cr, Mo, W, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sn, and Pb.

84. The catalyst-ceramic body according to claim 80, wherein said honeycomb structure has at least one of oxygen vacancies and lattice defects in the cordierite crystal lattice, on which a catalyst component is supported.

85. The catalyst-ceramic body according to claim 80, wherein said honeycomb structure has a multiple number of fine cracks in at least one of the amorphous and the crystal phases thereof, on which a catalyst component is supported.

86. The catalyst-ceramic body according to claim 85, wherein said fine cracks have widths of not more than 100 nm.

87. A process for producing a catalyst-body, comprising:  
preparing cordierite materials comprising a Si source, an Al source and a Mg source as well as a binder, some of said Si, Al and Mg sources being replaced by a noble metal-containing compound,  
forming said cordierite materials into a honeycomb shape,  
heating said honeycomb shape to remove said binder, and  
firing said honeycomb shape in a reduced pressure atmosphere at a pressure of not higher than 4000 Pa, a reducing atmosphere, an oxygen-containing atmosphere or an oxygen-free atmosphere to form a catalyst-ceramic body comprising a ceramic support of a honeycomb structure comprising a cordierite composition.

88. A process for producing a catalyst-ceramic body, comprising:



preparing cordierite materials comprising a Si source, an Al source and a Mg source as well as a binder, some of said Si, Al and Mg sources being replaced by a noble metal-containing compound and a Ce-containing compound,  
forming said cordierite materials into a honeycomb shape,  
heating said honeycomb shape to remove said binder, and  
firing said honeycomb shape in a reduced pressure atmosphere at a pressure of not higher than 4000 Pa, a reducing atmosphere, an oxygen-containing atmosphere or an oxygen-free atmosphere to form a catalyst-ceramic body comprising a ceramic support of a honeycomb structure comprising a cordierite composition.

89. The process according to claim 87, wherein said fired honeycomb structure is further heated to a predetermined temperature and then rapidly cooled from said predetermined temperature.

90. The process according to claim 87, wherein said fired honeycomb structure is further rapidly cooled to a predetermined temperature during cooling from a firing temperature.

91. The process according to claim 89, wherein a temperature difference between said predetermined temperature and the temperature after said rapid cooling is not more than 900°C.

92. The process according to claim 87, wherein said fired honeycomb structure is further subjected to a shock wave.

93. The process according to claim 92, wherein said shock wave is provided by ultrasound or vibration.

94. A process for producing the catalyst-ceramic body as set forth in claim 73, comprising depositing at least one of a catalyst component and a precursor of a catalyst component on said ceramic support by one of a CVD and PVD method.

95. A process for producing the catalyst-ceramic body as set forth in claim 73, comprising depositing at least one of a catalyst component and a precursor of a catalyst component on said ceramic support by means of a super critical fluid.

96. A process for producing the catalyst-ceramic body as set forth in claim 73, comprising depositing at least one of a catalyst component and a precursor of a catalyst component on said ceramic support by means of a solvent having a surface tension smaller than water.

97. A process for producing the catalyst-ceramic body as set forth in claim 73, comprising depositing at least one of a catalyst component and a precursor of a catalyst component on said ceramic support by means of a solvent having a surface tension smaller than water while applying one of vibration and performing vacuum defoaming.

98. A process for producing the catalyst-ceramic body as set forth in claim 73, comprising depositing at least one of a catalyst component and a precursor of a catalyst component on said ceramic support by a heat treatment.

99. A process for producing the catalyst-ceramic body as set forth in claim 73, comprising depositing a catalyst component a plurality of times using the same or different catalyst compositions.

102. The catalyst-ceramic body according to claim 80, wherein said cordierite has a composition corresponding to a composition expressed by  $2\text{MgO} / 2 \cdot 2\text{Al}_2\text{O}_3 \cdot 5\text{SiO}_3$ .

103. The process for producing a catalyst-ceramic body according to claim 89, wherein said cordierite has a composition corresponding to a composition expressed by  $2\text{MgO} / 2 \cdot 2\text{Al}_2\text{O}_3 \cdot 5\text{SiO}_3$ .

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